

A-000000000

Decision Criteria for Field Application

Field radiological anomalies are small areas that exhibit levels of residual contaminants that exceed or are above the average levels of the site. The presence of anomalies indicates that the assumption of homogeneous distribution is incorrect. Therefore, the impact of such areas must be evaluated as to the effect upon larger areas and the environment. DOE Order 5400.5 and DOE/CH-8901 provide specific guidance as to the identification and quantification of radiological anomalies. These documents have been utilized to develop a methodology for identifying anomalies that exhibit an imminent hazard or risk to the general public and the environment.

The following information concerning anomalies is taken from DOE/CH-8901, Section 3.3.2, Hot Spot Criteria for Field Application.

Hot spots are small areas that have levels of residual radioactive material that are considerably above the levels in the surrounding area. The derivation of remedial action criteria generally assumes homogeneous contamination of large areas (several hundred square meters or more), and the derived concentration guide is stated in terms of concentrations averaged over an area of 100 m². Because of this averaging process, within these 100 m² areas hot spots can exist that contain concentrations of radionuclides that are significantly higher than the authorized limit. Therefore, the presence of hot spots could potentially pose a greater risk of exposure to individuals using the site than the risk associated with homogeneous contamination. In order to ensure that individuals are adequately protected and to ensure that the ALARA process is satisfied, the following hot spot criteria must be applied along with the general criterion for homogeneous contamination. The hot spot criterion for field application is

$$M = \sum_i S_i / G_i(t_m) \leq 1$$

where

M = hot spot mixture sum for field use,
 S_i = measured concentration of the i^{th} principle radionuclide in the hot spot (pCi/g), and
 $G_i(t_m)$ = single radionuclide soil guideline for the i^{th} principal radionuclide in the hot spot (pCi/g)

The measure hot spot concentrations S_i are the peak concentrations if the hot spot area is 1 m² or less or the average concentrations if the hot spot area is larger than 1 m².

The formula for single radionuclide, hot spot soil guidelines is

$$G_i = G_i(t_m) \times (100/A)^{1/2}$$

where

$G_i(t_m)$ = as defined for Equation 3.4 (Residual Soil Guideline)
 A = area of hot spot (m²), and
 $(100/A)^{1/2}$ = hot spot multiplication factor

The Manual goes on to provide an interpretation and application of the values obtained. The basic intent is to provide a usable methodology for determining anomalies with derived residual guidelines.

A RESRAD analysis has been conducted using site specific radiological constituents present in OU-1. Using this site specific information, single radionuclide soil guidelines have been derived for ^{241}Am and ^{239}Pu . They are 33 pCi/g and 230 pCi/g, respectively, for ^{241}Am and ^{239}Pu . These values are derived by applying a farm habitat scenario, conservative default values, and a limiting annual dose of 100 mrem/yr. Applying the derived values to the equation as single radionuclide soil guideline,

$$G_i(t_m) = 33 \text{ pCi/g for } ^{241}\text{Am}$$

$$G_i(t_m) = 230 \text{ pCi/g for } ^{239}\text{Pu}$$

an action level for hot spots may be determined for ^{239}Pu and ^{241}Am .

The same equation may be applied to the FIDLER readings. A background reading for the Field Instrument for the Detection of Low Energy Radiation (FIDLER) has been established using field monitoring data from Operable Unit 1. By determining the mean of the sample population a background level of 3700 counts per minute (cpm) (2492 cpm +/- 1207 cpm) was calculated. This represents a 95% confidence level that the count rate if greater than 3700 cpm, is above the background, or action level, for the site. Substituting the action level count rate of 3700 cpm, initial criteria for hot spots may be established based upon the specific surface area. It is important to note that the FIDLER survey provides a methodology for the initial screening of potential anomalies.

Action Levels for ^{239}Pu , ^{241}Am , and FIDLER Readings based upon ranges for Hot Spot Multiplication Factors

Range	Hot Spot Mult Factor	FIDLER, G_i cpm	Am-241, G_i pCi/g	Pu-239, G_i pCi/g
<1 m ²	10 ^a	37000	330	2300
1 - <3 m ²	6	22200	198	1380
3 - <10 m ²	3	11100	99	690
10 - <25 m ²	2	7400	66	460

^aAreas less than 1 m² are to be averaged over a 1 m² area and that average shall not exceed 10 times the authorized limit.

Following is a summary of in situ radiation detection measurements and laboratory analysis of soil samples obtained from the hotspot. In addition to the FIDLER, gamma spectra of the hotspot were collected using the Portable Gamma Spectroscopy System (PGSS).

In Situ measurement and soil sample results of B-1 Retention Pond Hotspot

Surface Area m ²	FIDLER cpm	PGSS ²⁴¹ Am pCi/g	²⁴¹ Am pCi/g	²³⁹ Pu pCi/g
0.49	16774	7.6	157.7	1927

By applying the Hotspot Multiplication Factors to the derived single radionuclide soil guideline value, action levels for identified anomalies may be established based upon surface area and activity concentration, or field reading. By inference, activity levels detected at or below the calculated action levels do not require immediate removal.

Therefore, based upon the screening of the B-1 Retention Pond hotspot using the FIDLER, the PGSS, and soil sample data, the determination to leave the contamination in place pending remediation was the appropriate decision.